tungs- und Sachverhaltsfixierungs-Konkurrenzen. In: Felder, E. (Hg.): Semantische Kämpfe. Macht und Sprache in den Wissenschaften. Berlin, S. 13–46

Felder, E., 2009: Sprache – das Tor zur Welt!? Perspektiven und Tendenzen in sprachlichen Äußerungen. In: Felder, E. (Hg.): Sprache. Im Auftrag der Universitätsgesellschaft Heidelberg. Berlin, S. 13–57

Felder, E.; Müller, M. (Hg.), 2009: Wissen durch Sprache. Theorie, Praxis und Erkenntnisinteresse des Forschungsnetzwerks »Sprache und Wissen«. Berlin

Felder, E., 2012: Pragma-semiotische Textarbeit und der hermeneutische Nutzen von Korpusanalysen für die linguistische Mediendiskursanalyse. In: Felder, E.; Müller, M.; Vogel, F. (Hg.): Korpuspragmatik. Thematische Korpora als Basis diskurslinguistischer Analysen. Berlin, S. 115–174

Felder, E., 2013: Faktizitätsherstellung mittels handlungsleitender Konzepte und agonaler Zentren. Der diskursive Wettkampf um Geltungsansprüche. In: Felder, E. (Hg.): Faktizitätsherstellung in Diskursen. Die Macht des Deklarativen. Berlin, S. 13–28

Jacob, K. (in Vorb.): Linguistik des Entscheidens. Sprachliche Muster und Variationen in Entscheidensprozessen am Beispiel des politischen Diskurses um erneuerbare Energien unter diskurslinguistischen und funktional-pragmatischen Gesichtspunkten (Arbeitstitel einer an der Universität Heidelberg entstehenden Dissertationsschrift)

Klinke, A.; Dreyer, M.; Schweizer, P.-J. et al., 2007: Risiko – Über den gesellschaftlichen Umgang mit Unsicherheit. München

Köller, W., 2004: Sprache und Perspektivität. Zur Struktur von Objektivierungsformen in Bildern, im Denken und in der Sprache. Berlin

Kühn, P., 1995: Mehrfachadressierung. Untersuchungen zur adressatenspezifischen Polyvalenz sprachlichen Handelns. Tübingen

Luhmann, N., 1991: Soziologie des Risikos. Berlin

Renn, O., 1984: Risikowahrnehmung der Kernenergie. Frankfurt a. M.

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The Greenhouse Metaphor and the Footprint Metaphor

Climate Change Risk Assessment and Risk Management Seen through the Lens of Two Prominent Metaphors

by Brigitte Nerlich, University of Nottingham, and Iina Hellsten, VU University Amsterdam

This article charts the emergence and framing of anthropogenic climate change as risk through the lens of two metaphors: greenhouse effect and carbon footprint. We argue that the greenhouse effect metaphor provided the scientific basis for framing climate change as a risk, indeed it can be seen as part of risk assessment. The carbon footprint metaphor, in turn, can be seen as belonging to the domain of risk management, as through this and other related metaphors, such as carbon offsetting, carbon budgets and the like, policy makers try to act upon the scientific risk assessment delivered by the greenhouse metaphor and encourage human behaviour change that reduces the risks of unmanaged climate change. We investigate how these key metaphors spread both in English news articles and in natural and social science articles and how they may shape current discourses and actions on climate change.

1 Introduction

Metaphors, such as *greenhouse effect* and *carbon footprint*, have played an important role in shaping public images of climate change. Both metaphors have been powerful in evoking vivid understandings of what global warming means and how one should deal with it. We discuss the use of these two metaphors at the interface between science, policy and the news media. We believe that a better understanding of these metaphors is important in a context where it is increasingly believed that to make people understand climate change better and encourage political action to prevent it, mitigate it or adapt to it, climate change should be framed in terms of risk (Silverman 2013; Painter 2013). However, at the same time, it is also becoming clear that understanding scientific risk and uncertainty is a real challenge for the general public (Painter

2013; Painter 2014). While such discussions are going on, particularly in the context of the various reports published by the *Intergovernmental Panel on Climate Change* in 2013 and 2014, scientists and policy makers have forgotten that climate change has, for quite a while, been implicitly framed as risk, both in terms of risk assessment and risk management, namely through the use of the metaphors of the greenhouse effect and the carbon footprint. Knowing more about the emergence and spread of these two key metaphors may provide some historical background to current discussions of climate change as risk.

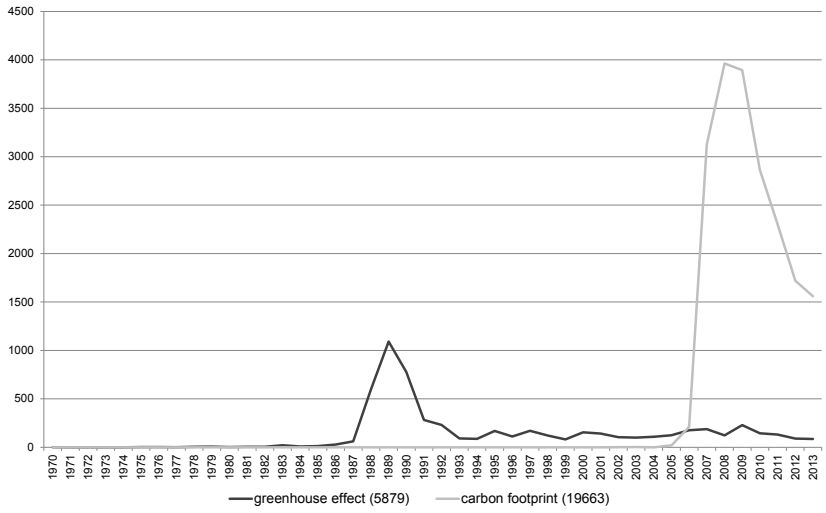
In this article we chart the emergence and framing of anthropogenic climate change as "risk" through the lens of two salient discourse metaphors: the greenhouse effect metaphor and the carbon footprint metaphor. By discourse metaphor we understand relatively stable metaphorical mappings that function as key framing devices within particular discourses over a certain period of time (Zinken et al. 2003). The greenhouse effect metaphor, or more precisely the anthropogenic or enhanced greenhouse effect metaphor, maps some of what we know about what happens in greenhouses onto what happens in the earth's atmosphere through human action. The carbon footprint metaphor maps some of what we know about footprints and their impact onto what we want to happen to the earth atmosphere through individual and collective actions.

We argue that the metaphor of the greenhouse effect was fundamental for a scientific framing of climate change as an emerging risk and was used by climate change communicators and policy makers to frame the threats and dangers posed by climate change in terms of what we now call "risk assessment" (or the systematic process of evaluating the potential risks that may be involved in a projected activity or undertaking). The carbon footprint metaphor in turn became fundamental for a policy framing of climate change in terms of "risk management" (or the forecasting and evaluation of risks and the identification of procedures to avoid or minimise their impact).

Through the carbon footprint and related metaphors, such as carbon offsetting, carbon budgets and the like, policy makers try to respond to and act upon the scientific risk assessment delivered by the greenhouse metaphor and encourage changes in human behaviour that might reduce the risks of unmanaged climate change. This framing of climate change through risk, with the greenhouse metaphor representing scientific risk assessment and the carbon footprint representing policy-oriented risk management, also allows policy makers to establish a linear link between science/risk assessment and policy/risk management. This linear science-policy link is based on quantifying risks (measuring the rise in greenhouse gases) and quantifying the management of these risks (measuring carbon footprints in order to reduce greenhouse gas emissions). This means that the two metaphors together tell a convincing story and at the same time allow measurements to take place. However, in recent years, such a linear science and risk-based framing of political climate change action has become highly contested (Hulme 2014), and we shall come back to this issue at the end of the article.

In order to investigate how these two key metaphors for climate change science and policy emerged and spread in the press and in science articles, we constructed timelines for the frequencies of use of the two metaphors in both natural and social science articles and in news articles. First, we downloaded articles indexed in the Web of Science database between 1900–2013, using the metaphors as our search terms in title search ("greenhouse effect" and "carbon footprint"). Second, we constructed similar timelines for the use of these terms in newspapers indexed in the LexisNexis database (excluding online resources), all-English news, in headlines or the lead of news items. This frequency analysis provides an indication of when these topics became part of the science and the mass media agenda. To complement the frequency analysis, we conducted qualitative analysis of the main trends in the use of these two metaphors over time. We argue that the two metaphors laid the foundations for a risk-based discourse that seems to have become the focus of recent communication efforts, but may also have become a communication barrier, as some argue that climate change is not a "problem" that has a "solution", but is a much more complex, multifaceted and cultural phenomenon (Hulme 2009).

Fig. 1: Greenhouse effect and carbon footprint in newspapers, in headlines or lead (via LexisNexis), 1970–2013



Source: Own compilation

In section 2 we describe how the metaphors of the greenhouse effect and of the carbon footprint emerged and how their use changed over time in the news and in science articles. In sections 3 and 4 of this article we then study each metaphor in more detail.

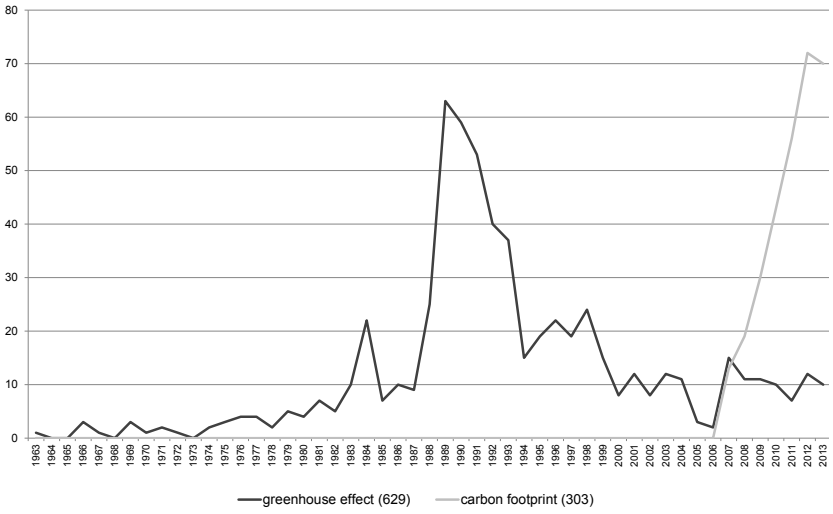
2 Greenhouse Effect and Carbon Footprint

As the following graph of English speaking news coverage shows, these two metaphors emerged at crucial junctures in the evolution of global debates about climate change (Fig. 1). The greenhouse effect metaphor became salient around 1988 when climate science became a political issue (Jaspal/Nerlich 2014), that is, when measurements of increasing greenhouse gases began to tell a story about anthropogenic climate change and its possible impacts.

The carbon footprint metaphor became salient some 15 years later when policy makers began to explore new options to measurably reduce greenhouse gas emissions (and amongst the greenhouse gases, reduce carbon dioxide or carbon emissions in particular) in the context of the publication of various seminal reports on climate change and emissions trading published between 2005 and 2007. 2007 was also a peak in newspaper coverage as documented by Max Boykoff (http://sciencepolicy.colorado.edu/media_coverage/).

The two peaks in the news graph point to turning points in the climate change debate: one when climate change risks began to be assessed by measuring the rise in greenhouse gases and one when efforts were made to try and manage them by trying to induce individuals, households, towns, nations and so on to reduce greenhouse gas emissions by making them aware of their "carbon footprints" (see Fig. 1 and 2).

Fig. 2: Greenhouse effect and carbon footprint in titles in Web of Science, 1963–2013



Source: Own compilation

Interestingly, the science peak preceded the news peak for the greenhouse metaphor, while it was the other way around for carbon footprint. This may relate to the fact that the risk of climate change was "discovered" by science whereas risk management originates from policy.

3 The Greenhouse Metaphor

The metaphor of the greenhouse effect has a long and venerable history in physics and atmospheric sciences. According to the *Oxford English Dictionary (OED)*, the greenhouse effect was first described by the French physicist J.B.J. Fourier in 1827 but without using an equivalent expression (OED, online). "The argument and the evidence was further strengthened by Claude Pouillet in 1827 and 1838, and reasoned from experimental observations by John Tyndal in 1859, and more fully quantified by Svante Arrhenius in 1896" (Greenhouse effect, Wikipedia; http://en.wikipedia.org/wiki/Greenhouse_effect). The first metaphorical attestation of the greenhouse effect can be found in a geological magazine published in 1867 where the atmosphere is compared to "an immense dome of glass", and transformed into "a great Orchid-house" (OED, online). In 1907, J. H. Poynting used the words "blanketing effect" and "greenhouse effect" (ibid.), with "blanket" being something like a subsidiary metaphor to greenhouse. In 1917, Alexander Graham Bell used the phrase "greenhouse effect" and began to advocate low-carbon energy options. In 1928, Arrhenius described the greenhouse effect and the influence of carbon dioxide on the atmosphere in detail. Since then, the greenhouse effect metaphor has become a staple of climate science, mapping our everyday knowledge of greenhouses onto new understandings of the atmosphere. The atmosphere/greenhouse gases are compared to the glass in a greenhouse, the earth to the plants inside, and the sunlight that warms both is the same. However, one should stress that things are much more complex than this simple mapping makes it seem!

The first article to use the phrase "greenhouse effect" in our *news corpus* appeared in *The New York Times* on 2 August 1970. It is a rather telegrammatic report from MIT which talks about the "increasing quantities of carbon dioxide in atmosphere (believed to raise temps by 'greenhouse effect')". The last article in our timeline, published on 30 December 2013, was published in the *Charleston Gazette (West Virginia)* by Buckley (2013) entitled "Earth Talk: Explaining climate change to kids can be fun", in which the explanation of climate change begins with the greenhouse effect. This shows how much this metaphor has become part of climate change communication.

The greenhouse effect metaphor started to take hold in the 1980s, with a first peak in 1984 after the seminal publication of a paper by James Hansen (Hansen et al. 1984), but taking off after 1988, the year that climate change became a political issue. The highest peak was reached a year before the first Rio summit in 1992, when scientists really pushed for global action on climate change. After that one can see a gradual decline, followed by a bit of an upward trend between 2007 and 2010, in the wake of the 4th IPCC report in 2007 and renewed attempts by politicians to get action on climate change on the agenda, followed by the collapse of the Copenhagen summit in 2009 after "climategate" (Nerlich 2010). This shows that the discourse metaphor of the greenhouse effect had discursive staying power, despite some ups and downs.

The earliest examples of *science articles* dealing with the greenhouse effect (mid-1960s) focus on atmospheres on other planets, such as Mars and Venus, with speculations that the greenhouse effect may make Mars habitable (King 1963). The first article on "Man-made carbon-dioxide and greenhouse effect" seems to be from 1972 (Sawyer 1972). There was a huge increase in the volume of articles using this metaphor in the late 1980s/early 1990s, when climate science entered politics. McGourty (1988) called for governmental action to global warming in *Nature.* The science seemed settled (and the greenhouse effect metaphor seemed to show that this was the case). What still needed to be done was to act on scientific evidence and reduce greenhouse gas emissions, that is, mitigate the anthropogenic greenhouse effect. Patterson (1991) suggests exactly that in 1987 and 1988 media frames focusing on scientific aspects were replaced by frames focusing on policy aspects, but it took another 15 years until a salient policy metaphor was found that could convey a

clear and comprehensible message about what to do about climate change. Importantly, the carbon footprint metaphor matched the greenhouse effect metaphor in so far as both were based on making something invisible visible and, most importantly, quantifiable: the increase in greenhouse gas emissions leading to the greenhouse effect or global warming on the one hand (what one would nowadays call "risk assessment") and the quantifiable reduction of greenhouse gases on the other, most importantly carbon dioxide (what one would nowadays call "risk management").

4 Carbon Footprint Metaphor

Unlike the greenhouse effect metaphor, the carbon footprint metaphor is a more recent addition to the metaphorical framing of climate change that emerged during a period of hope that climate science was settled, again, and that the only thing that still needed to be done was to change people's behaviour, in terms of reducing greenhouse gas emissions, on the planetary, national, local, and individual scale and thus stall the greenhouse effect. The "carbon" in carbon footprint stands for carbon dioxide, which stands for all greenhouse gases.

The OED defines carbon footprint as "the environmental impact of carbon emissions; a measure of the carbon emissions of a particular individual, organization, or community" (OED, online). Carbon footprint was probably coined in analogy to "ecological footprint", which emerged in 1992, according to the OED, in the sense of "(a measure of) the impact of a person, community, or organization on the environment in terms of resource use, esp. expressed as the area of land in hectares required to sustain a prevailing pattern of production and consumption". The first attestation of "carbon footprint" in the OED is from 1999 when the phrase was used on a BBC food programme: "To cancel out the damage we do, Morrell believes we should plant trees, and that in doing so an individual or organisation can erase their carbon 'footprint'." In 2007, at the height of the climate change debate and around the publication of the 4th IPCC report, carbon footprint became the OED's "word of the year". The phrase "carbon footprint" became the blueprint for many other so-called "carbon compounds", such as "carbon budget", "carbon tax", "carbon offsetting", etc., especially those coined within the framework of "ecological modernisation", that is, the belief that economic growth and environmentalism can go together (see Koteyko et al. 2010).

As Fig. 1 demonstrates, "carbon footprint" exploded rapidly *in news articles* around 2004/05. The oldest reference can be found in a 2001 article reporting on various government schemes: "The federal government may not want to do much about global warming, but you can. SafeClimate offers a 'carbon footprint calculator' and other resources that show you how to take action." (USA Today 2001) Older articles seem to focus on calculating footprints and ways to reduce footprints. More recent articles tend to take the meaning for granted, and use the term as an explanation for organisations' actions. The last article in our sample using "carbon footprint" was published on December 31, 2013 in the *Cambodian Business Review* (http://www.cambisreview.com/) and deals with organic agriculture.

In *science*, the article in *Nature* entitled "Time to give due weight to the 'carbon footprint' issue" (Hammond 2007) is the first one. In the following years, several articles deal with reducing carbon footprints through manufacturing processes involving specific raw materials, such as copper, within different types of industries or specific companies, such as Hyundai Motors, or products, including bread. Later the debate moves to discussing the carbon footprint of individual households, countries or the whole of the EU, and zero-carbon options are discussed, including zero-carbon cities. And finally, consumer actions such as footprint labelling or carbon labelling of supermarket products are debated. Everyday life becomes part of a global effort in risk management, also called climate change mitigation, an effort in large part on being able to measurably reduce emissions, from the individual to communities to nations and the planet as a whole.

5 Discussion and Conclusion

The two metaphors discussed here evoke different images of global warming, in two inter-linked ways. The greenhouse effect metaphor made the very complex topic of global warming imagin-

able by linking it to a familiar object. It also made the risks (overheating) clear for the planet. The carbon footprint metaphor, in turn, made it possible to imagine individuals' own contributions to the greenhouse effect and the risks it poses.

The image of greenhouse effect originated in the sciences and was taken up by the news media because of the intriguing story-line and shared responsibility for the planet Earth, while the metaphor of the carbon footprint opened up a market-based policy vision of how to deal with carbon emissions and a way of allocating individual and group responsibility for risk reduction. Both metaphors are linked through the action of "measurement" – measuring the rise of greenhouse gas emissions on the one hand, budgeting and trading the reduction of greenhouses gases (and carbon dioxide in particular) on the other. While the greenhouse effect metaphor exposed the risks posed by climate change and allowed scientists to *assess* the risks associated with climate change (the increase in greenhouse gases which lead to global warming and climate change), the carbon footprint metaphor makes visible and allows measuring and *managing* the risks associated with climate change. Both together can be seen as two reasonable steps in risk reduction.

However, things have not been that simple. Both metaphors have been caught in a network of polarised discourses and institutionalised delay, and both the science of climate change and climate change policies have become mired in controversy leading to continued political paralysis while risks to the climate, the planet and humanity are increasing. Some hope that a risk-based framing may improve this situation. As James Painter (2013) has pointed out, "[s]cientists and politicians are increasingly using the language of risk to describe the climate change challenge". However, he found in his media analysis that this risk language is not taken up in the media (Painter 2014) and, in consequence, has only a slight chance of influencing public perception.

There is therefore a certain risk attached to this type of climate change communication in terms of risk. As our article has shown, even framings that only implicitly frame climate change as risk, rather than doing so explicitly, only influence public perceptions for short periods of time. Communicating climate change risks successfully remains a great challenge.

Acknowledgement

The authors gratefully acknowledge funding for the "Climate change as a complex social issue" project, ESRC (RES-360-25-0068) and NWO (NWO-ORA grant 464-10-077). We are grateful to Sandra van der Hel for helpful comments on an earlier version of this paper.

References

Buckley, P., 2013: Earth Talk; Explaining Climate Change to Kids Can Be Fun. In: Charleston Gazette, 30 Dec. 2013; http://charleston-gazette.vlex.com/vid/earth-talk-climate-change-to-kids-fun-483642382 (download 13.9.14)

Hammond, G., 2007: Time to Give Due Weight to the 'Carbon Footprint' Issue. In: Nature 445/256 (2007), p. 256

Hansen, J.; Lacis, A.; Rind, D., 1984: Climate Trends Due to Increasing Greenhouse Gases. In: Proceedings of the Third Symposium on Coastal and Ocean Management, ASCE/San Diego, California, June 1–4, 1983, pp. 2796–2810

Hulme, M., 2009: Why We Disagree About Climate Change: Understanding Controversy, Inaction and Opportunity. Cambridge

Hulme, M., 2014: Science Can't Settle What Should Be Done About Climate Change. In: The Conversation 4 February 2014; https://theconversation.com/science-cant-settle-what-should-be-done-about-climate-change-22727 (download 13.3.14)

IPCC – Intergovernmental Panel on Climate Change, 2013: Summary for Policymakers. In: Stocker T.F.; Qin, D.; Plattner, G-K. et al. (eds.): Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK; http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf (download 11.7.14)

Jaspal, R.; Nerlich, B., 2014: When Climate Science Became Climate Politics: British Media Representations of Climate Change in 1988. In: Public Understanding of Science 232 (2014), pp. 122–141

King, J.I.F., 1963: Greenhouse Effect in Semi-infinite Atmosphere. In: Icarus 25/6 (1963), pp. 359–363

Koteyko, N.; Thelwall, M.; Nerlich, B., 2010: From Carbon Markets to Carbon Morality: Creative Compounds as Framing Devices in Online Discourses on

Climate Change Mitigation. In: Science Communication 321 (2010), pp. 25–54

McGourty, C., 1988: Government Action Needed to Mitigate Greenhouse-effect. In: Nature 336/6195 (1988), p. 99

Nerlich, B., 2010: "Climategate": Paradoxical Metaphors and Political Paralysis. In: Environmental Values 19 (2010), pp. 421–422

OED – Oxford English Dictionary, 2012: Retrieved from http://oxforddictionaries.com/

Painter, J., 2013: Climate Change in the Media: Reporting Risk and Uncertainty. Reuters Institute for the Study of Journalism, University of Oxford, I.B. Taurus, London and New York

Painter, J., 2014: The IPCC's Risky Talk on Climate Change. Carbon Brief (blog); http://www.carbonbrief.org/blog/2014/04/the-ipccs-risky-talk/ (download 11.7.14)

Patterson, W.C., 1991: Energy Policies and the Greenhouse-effect. In: Energy Policy 194 (1991), pp. 409–410

Sawyer, J.S., 1972: Man-made Carbon-dioxide and Greenhouse Effect. In: Nature 239/23–26 (1972), p. 23

Silverman, H., 2013: Amidst Uncertainty, Perceiving Risk. Blog 18 October, 2013; http://www.solvingforpattern.org/2013/10/18/amidst-uncertainty-perceiving-risk/ (download 19.11.13)

USA Today, May 3, 2001: http://usatoday30.usatoday.com/life/cyber/2001-04-24-hotsites.htm (page removed when last accessed 15.3.14)

Zinken, J.; Hellsten, I.; Nerlich. B., 2003: What is "Cultural" About Conceptual Metaphors? In: International Journal of Communication 131–2 (2003), pp. 5–29

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Diskursrisiken der Kommunikation von Nichtwissen

Der Fall „Nanotechnologie"

von Andreas Lösch, ITAS

Technologien, wie zum Beispiel die Nanotechnologie, konfrontieren ihren Betrachter mit vielseitigem Nichtwissen. In Regulierungsdebatten wird dieses Nichtwissen über unerwünschte Folgen neuer Technologien häufig als Risiko thematisiert. Der Beitrag zeigt mit Hilfe diskursanalytischer Einsichten in die Regulierungsdebatte der Nanotechnologie, inwiefern die Kommunikation von potenziellen Risiken und Folgenverantwortungen eine diskursive Bedingung der Plausibilisierung und Legitimierung für die Governance neuer Technologien darstellt. Verdeutlicht wird auch, welche Diskursrisiken diese risikoförmige Kommunikation des Nichtwissens über die Folgen neuer Technologien erzeugt.

1 Einleitung

Komplexe und vielschichtige Technologien, wie „die Nanotechnologie" oder „das Energiesystem" konfrontieren den Betrachter mit vielseitigem Nichtwissen. Von der Nanotechnologie zum Beispiel wurden und werden höchst heterogene Innovationen in ganz unterschiedlichen Bereichen (z. B. neue Materialien, Medizintechniken, Pharmazeutika, Informationstechnologien) erwartet. Aufgrund der Vielfalt möglicher Produkte, in denen durch nanotechnische Verfahren unterschiedliche Nanopartikel in unterschiedlichen Verbindungen eingesetzt werden können; aufgrund der unzähligen ökologischen und sozialen Umwelten, in denen diese Produkte genutzt werden und mit diesen interagieren können, ist das Spektrum potenziell erwünschter und unerwünschter Effekte der Nanotechnologie nahezu unbegrenzt (z. B. Lösch et al. 2009, S. 26ff.). Entscheidungen und Handlungen, sei es in der Forschung und Entwicklung, in der Herstellung und Vermarktung oder auch in Bezug auf die Regulierung und Governance sich formierender und transformierender Technologien, orientieren sich an Innovations- und Risikoerwartungen.